The Hydrogen Energy Association's response to the Department for Business and Trade's the Green Paper on 'Invest 2035: the UK's modern industrial strategy'

22nd November 2024

Opening remarks

This submission from the Hydrogen Energy Association (Formerly the UK Hydrogen and Fuel Cell Association) is in response to the 'Invest 2035: the UK's modern industrial strategy' Green Paper. The Hydrogen Energy Association (HEA) is the leading pan-UK trade body in the hydrogen energy sector, with a mission to support the growth of our members and the sector, and to ensure that the right policy framework is in place. Our 110 plus member companies represent over 200,000 employees globally, with combined revenues over £400 billion, and cover the entire value chain from raw material sourcing, to supply chain and components, financing, professional services, B2B and consumer facing solutions.

With over 15 years of experience, the HEA is a leader in advocating for and accelerating the transition to Net Zero in the UK through the deployment of hydrogen & fuel cell solutions. We promote and represent our members' interests across the hydrogen space, and campaign for the best policy outcomes for the industry across the full range of applications and opportunities.

Summary

The global demand for hydrogen technology is expected to increase to £700 billion annually by 2050, and there is an opportunity for the UK to be at the forefront of this new global industry, generating jobs and exports across the UK. With a ten-year window of opportunity to convert investment in innovation into globally competitive supply chains, the UK must act now to secure a leading position.

Actions needed to deliver leadership are as described in the Consultation and encompass access to finance, supply chain development, regulation, skills, innovation and prqactical considerations. More broadly, the development of a UK hydrogen economy based around production, storage, transportation and use will not only support our economic objectives and export aspirations, but also facilitate a cost-effective energy transition to net zero and enhanced resilience. Our response to this Consultation considers how the UK's Modern Industrial can support hydrogen development across the value chain, simultaneously delivering growth driving businesses for now and in the future.

Q.4 What are the most important subsectors and technologies that the UK government should focus on and why?

Hydrogen is key to delivering UK Government objectives in decarbonisation, energy resilience and clean growth and, as such, should be at the heart of the Industrial Strategy. Given its critical role, we recommend that that hydrogen be allocated its own subsector. This will help to ensure an appropriate focus on hydrogen across all elements of the Strategy. The UK, like the rest of the world, is at the start of its hydrogen journey, and by giving this level of coverage, the Strategy will help position UK firmly at the front of the global race for this multi-billion dollar market.

Hydrogen for jobs and growth

- The global demand for hydrogen technology is expected to increase to £700 billion annually by 2050, and there is an opportunity for the UK to be at the forefront of this new global industry, generating jobs and exports across the UK [1].
- The UK economic opportunity out to 2030 is £11bn, with 12,000 high quality jobs focused in Teesside, across North-West & North Wales, Humber, Scotland and South-West, and many more in the supply chain. These jobs will encompass engineering, construction, manufacturing and service sectors among others.
- A 10% share of the hydrogen technology market alone could deliver £70bn revenue and £46bn GVA per annum to the UK economy by 2050 as well as 410,000 jobs.
- Existing skills in oil and gas can help us provide global leadership in hydrogen.

Hydrogen for energy resilience

- Hydrogen is pivotal for achieving a decarbonised power system by 2030, ensuring flexibility and complementing high levels of intermittent renewable generation.
- Hydrogen allows us to balance supply and demand as we work towards our 50GW of offshore wind by 2030, with hydrogen storage as a vital buffer.
- In 2022 alone, there were 200 occasions when National Grid ESO had to pay Scottish wind farms to shut off their turbines, adding £800 million to consumer electricity bills and increasing greenhouse gas emissions by 1.3 million tonnes.
- Savings of £38bn have been identified if hydrogen is used to store energy to balance offshore wind and solar when the wind isn't blowing and the sun isn't shining [2].

Hydrogen for net zero

- The UK will not achieve its decarbonisation ambitions without hydrogen[3].
- Hydrogen's key role is in hard to abate sectors, where electrification is not possible or is disproportionately expensive – heavy industry (e.g. steel / cement / asphalt / chemical manufacturing, material handling), heavy duty transport (e.g. road, shipping, rail, aviation), power.
- 500,000 businesses currently rely on natural gas; one third of these cannot electrify.
- By 2050, hydrogen could account for 35% of final energy demand.

The time for action is now

Nations across the world are pressing forward with the roll-out of hydrogen. At this stage, the race is not yet won, and there is a ten-year window of opportunity to convert investment in innovation into

[1] https://hydrogeninnovation.co.uk/wp-content/uploads/2024/04/UK-Hydrogen-Innovation-Opportunity.pdf

[2] Benefits of long-duration electricity storage (publishing.service.gov.uk)

[3] For example, although renewable electricity has grown significantly, electricity continues to make up only 20% of UK's energy mix. Among other things, hydrogen can help to decarbonise sectors currently reliant on natural gas, which accounts for over 40% of UK energy usage. https://assets.publishing.service.gov.uk/media/664c827ff34f9b5a56adcb5d/UK_Energy_in_Brief_2023.pdf

globally competitive supply chains and thus take a leadership position[4] – ensuring that the UK not only has access to growth stimulating solutions to meet its needs, but also to open up a multi-billion-pound global market.

Of the eight subsectors listed in the Consultation, clean energy industries and advanced manufacturing are the most relevant. In fact, zero and low carbon hydrogen are enablers for a range of sub-sectors, including advanced manufacturing.

Q.5 What are the UK's strengths and capabilities in these subsectors?

The UK has a growing base of hydrogen technology supply chain companies, world-class scientific foundations and an increasing range of projects. Figure one shows the HEA's hydrogen project map, which showcases 70+ projects across the value chain.

Figure 1: The HEA's UK Hydrogen Project Map

The projects shown in Figure 1 are just the start of a strong project pipeline extending across production, storage, transportation and use. This is underpinned by robust engineering and construction capabilities. While the UK is characterised by a range of emerging technology companies with unique offerings and intellectual property (IP), these companies require significant investment to graduate from a technology company to an established subsystem supplier. Seizing the opportunity will open substantial growth potential for UK companies across the supply chain – allowing the UK to seize the 10% global market share, and hundreds of thousands of jobs, referenced in Question 4.

[4] https://hydrogeninnovation.co.uk/wp-content/uploads/2024/04/UK-Hydrogen-Innovation-Opportunity.pdf

A number of features of the UK favour the development of hydrogen here:

- The UK is **#1 in Europe for most attractive renewable energy investment** and deployment opportunities and 4th globally (2021 data).
- **Wind and solar are expected to reach above 50% of the UK's power production by 2030**, more than in any other IEA member country.
- The UK is the **4th most innovative place in the world**, based on the Global Innovation Index 2021.
- The UK Continental Shelf has **enough CO_2 storage capacity** to fully support the UK's demands **for hundreds of years**.
- The UK has a **world-leading gas network** with 85% of homes and businesses using natural gas for heating, cooking and hot water.
- Proactive **industry-lead growth institutions** are already set up and poised to drive growth and job creation e.g. Hydrogen Innovation Initiative / Hydrogen Skills Alliance (see Question 6)
- The UK has established skills capital in the oil, gas and engineering sectors ready to support the hydrogen transition. A good example is the world's largest renewable hydrogen plant in the middle east, which was largely designed in the UK.
- The UK has a globally renowned reputation in health and safety, the development of standards, and the management of risk.

Furthermore, work to decarbonise industry in industrial clusters through hydrogen and CCUS is delivering regional jobs across the UK is a particular strength. The Hynet and Humber / Teesside clusters alone will generate tens of thousands of jobs.

The HEA has worked closely with the Hydrogen Innovation Initiative on the development of the 'Hydrogen Innovation Opportunity'[5] and supporting documents, such as the UK Capabilities report[6]. This report notes the following key areas of strength and opportunity across production of hydrogen and conversion into carriers, propulsion systems for transport and power, Industrial hydrogen for feedstock and heat and end-to-end hydrogen storage:

- *"Technologies in emerging markets where the UK has strong academic and industrial innovation capabilities. Examples…. include: thermochemical hydrogen production; solid state hydrogen storage technologies; cryogenic hydrogen storage and technologies that support hydrogen carriers, particularly ammonia crackers.*

- *Areas where the UK has manufacturing capabilities or IP in a growing market that could support initial market deployment. Examples include: electrolysers and fuel cell technologies and components; carbon fibre-based hydrogen storage; Carbon Capture, Usage and Storage (CCUS) technologies and compressors."*

At this stage, the global hydrogen race is not yet won, and there is a ten-year window of opportunity to convert investment in innovation into globally competitive supply chains and thus take a leadership

[5] https://hydrogeninnovation.co.uk/wp-content/uploads/2024/04/UK-Hydrogen-Innovation-Opportunity.pdf
[6] https://hydrogeninnovation.co.uk/wp-content/uploads/2024/04/UK-Capabilities.pdf

position[7] – ensuring that the UK not only has access to growth stimulating solutions to meet its needs, but also to open up a multi-billion-pound global market.

Q.6 What are the key enablers and barriers to growth in these subsectors and how could the UK government address them?

There has been considerable work done to define the enablers and barriers to growth in hydrogen and consider routes to their resolution. This includes:

- The Hydrogen Skills Alliance: In its Workforce Assessment, key challenges facing the hydrogen skills landscape were identified, including competing skills and labour shortages across high growth sectors, such as civil, control and infrastructure engineers, pipe wilders and mechanical and pipe fitters, as well as uncertainty around workforce demand, lack of training provider capacity and regulator expertise at a local level. Government support in the establishment of a Hydrogen Skills Academy would be an efficient way to tackle these challenges. The Academy would serve as a network of excellence for aggregating and delivering hydrogen-related skills via regional hubs ensuring high quality hydrogen skills can be delivered at a time and place needed by employers.

- The Hydrogen Innovation Initiative: Focused on supply chain development through innovation, this suite of reports (see references 1 and 2) describes how the UK can capitalise on early mover advantage and seize its share of the global market. It identifies four strategic areas of opportunity that represent the biggest potential for UK industry and will provide export-led, high growth markets for domestic companies and supply chains.

- Various reports commissioned by the Hydrogen Delivery Council[8] and covering areas such as supply chains, demand for hydrogen, hydrogen internal combustion engines in Non-road Mobile Machinery (NRMM)

- 'Key barriers to the development of hydrogen in the UK energy system'[9]: This report by the Energy Systems Catapult identifies seven barriers: clear government direction and ambition; culture of decision and policy making; market and regulatory innovation for storage and flexibility; education; coordination planning; standards and standardisation; and the planning sector.

Hydrogen will and must be deployed across the UK. An early focus on decarbonisation of major industrial clusters, with the first comprising HYNET (the Northwest and North Wales) and the east coast cluster (comprising the Humber and Teesside – and accounting for 50% of the UK's industrial cluster CO_2 emissions), provides a basis from which to build.

Barriers of particular note are:

- demand for hydrogen – see Question 7 below.
- access to finance - especially securing investor confidence: see Question 7 and 10;
- skills - see recommendations from the Hydrogen Skills Alliance;

[7] https://hydrogeninnovation.co.uk/wp-content/uploads/2024/04/UK-Hydrogen-Innovation-Opportunity.pdf
[8] https://www.gov.uk/government/groups/hydrogen-delivery-council
[9] https://es.catapult.org.uk/report/key-barriers-to-the-development-of-hydrogen-in-the-uk-energy-system/

- competition - see Question 18;
- regulation - particularly working through regulatory frameworks that are struggling to evolve at the rate needed: see Question 20;
- scaling up supply chains - see recommendations from the Hydrogen Innovation Initiative;
- technology adoption - where building demand is key for hydrogen: see Question 10;
- practical considerations – energy prices, infrastructure, grid connections and planning: see Question 14; and
- whole system approach - lack of inclusive support framework to deliver the entire value chain from production to use: see question 7, 10, and 15.

See also Question 4 and its description of the high-level drivers for hydrogen in the UK.

The barriers described above will be overcome through a combination of measures working in tandem. These include:

1. Stimulating investment in hydrogen by ensuring:
    a. delivery for the whole of the UK – spreading investments, projects, supply chains and hydrogen skills across all four nations;
    b. coverage of the full range of low carbon hydrogen production routes to deliver compatibility across net zero, regional growth, and economic security and resilience.
    c. A long-term view (e.g. defining the funding / support framework for hydrogen production beyond Hydrogen Allocation Round 4) – providing reassurance to private investors of the Government's commitment; and
    d. Alignment with other key initiatives such as Great British Energy, the National Wealth Fund, the planned Infrastructure Strategy etc.

2. A mix of 'sticks' and 'carrots':
    a. alignment with international trends (e.g. Europe, to allow exchange without tariffs);
    b. being self-supported by market (i.e. Obligation and Certificates); and
    c. encompassing demand for hydrogen, including targets for hydrogen use (equivalent to Europe's REDIII industrial and transport mandates – see also Question 18) combined with strong compliance incentives (e.g. fines for non-compliance), CAPEX support, and development of inland hydrogen hubs where lower-risk shorter term contracts between producer and users would be more feasible.
    d. including increasing restrictions and penalties for carbon emitting technologies and equipment to stimulate a move towards low- and zero-carbon alternatives, such as hydrogen.

3. Measures to stimulate international trade:
    a. establishing infrastructure to enables a more efficient international trade (including, for example, the import of green ammonia to support the production of green fertilisers etc.);
    b. a trade strategy to provide investor certainty on the UK's hydrogen export ambitions of low carbon hydrogen fuel and technology.

Economic growth depends on the speed at which investment can be put into play. Delays in decision, strategy and planning slows down the investment and therefore reduce the growth of the economy and decarbonisation. The UK needs to move at speed to capture the benefits of being a leader in hydrogen.

Q.7 What are the most significant barriers to investment? Do they vary across the growth-driving sectors? What evidence can you share to illustrate this?

The barriers highlighted in Question 6 all have investment related aspects. Ways in which these barriers can be overcome are discussed throughout this document.

At the system level, a key barrier to investment is long term certainty. It is vital for the hydrogen sector's growth that momentum is clearly maintained. Robust and coherent messaging from government, underpinned by long term frameworks and levers, will ensure the inflow of the private capital needed to deliver. There must also be consistency across all Government departments, with a clear vision, aligned across timescales and milestones, cascaded through and across all relevant Government targets and commitments.

In terms of hydrogen funding mechanisms and government support, a key barrier to investment is the open risk that developers are exposed to within the Low Carbon Hydrogen Agreement (LCHA), most notably if production volumes drop or a partnership with a user breaks down. If UK hydrogen production, in particular electrolytic hydrogen, is to compete for investment, investors must be assured that the risk of losing revenue support, on which many projects rely, is sufficiently mitigated. When a competitive free market is successfully established, there will be a sufficient number of end users to manage this risk, but the LCHA must contain enough flexibility in the meantime to allow the transition to free market conditions.

Ensuring the efficacy of funding mechanisms such as the Hydrogen Production Business Model (HPBM) is vital, as arguably the largest barrier to hydrogen solutions is the initial investment costs of technology and infrastructure. The total cost of ownership of hydrogen assets, including not only OPEX and CAPEX, but also network charges, levies, energy inputs, and policy costs, are not always factored into funding opportunities.

Another major challenge facing the roll-out of hydrogen is building up demand. Whilst government support is helping to bring down the price of hydrogen, users are often faced with the need to change processes and technologies to adapt them for hydrogen use. They are also required to sign-up to multi-decade contracts when the market pathway for hydrogen is still evolving. Furthermore, pipeline networks to bring together producers and users will not be available for a number of years. The combination of these factors is making it difficult to attract private investment into projects. The evidence for this lies in industry's response to the first Hydrogen Allocation Round (HAR).

Also relevant to the challenge of stimulating hydrogen demand are specific policies that are slowing the transition to hydrogen in various ways. Existing policies originally designed for fossil fuel or renewable energy users must keep pace with and adapt to the hydrogen economy as it develops, ensuring that stakeholders looking to invest in hydrogen are incentivised, or at the very least not disadvantaged. Evidence of such policies include the Climate Change levy (CCL). The LCHA considers levies on imported electricity to be a pass-through cost, and so if the CCL is payable by green hydrogen, end customers' CCL cost would increase from £7.75/MWh to £11/MWh, and increase by £11/MWh in exempted sectors. Blue hydrogen is also explicitly exempted. The result of this policy is that exempted sectors will face CCL costs they were not intended to pay, causing a perverse incentive to continue to use natural gas (which is considered a non-fuel use and is not charged), as well as distorted ownership and contract structures between CCUS enabled and electrolytic hydrogen. In order for hydrogen to be economically viable as a decarbonisation option, it is crucial for any existing regulation that

disproportionately burdens hydrogen uptake be revised to accommodate and incentivise the new technology applications as much as possible.

Q.10 Where you identified barriers in response to Question 7 which relate to RDI and technology adoption and diffusion, what UK government policy solutions could best address these?

As mentioned above, hydrogen adoption is being limited by the lack of support for demand. In the broadest sense, stimulating hydrogen demand must include support for the innovation associated with the use of hydrogen, not just production, as well as some well-defined incentives for the users of hydrogen across all applications so that that the scale gap can be bridged in the early years of the hydrogen economy.

One solution to help bring forward demand would be for Government (potentially via Great British Energy) to invest in inland hydrogen hubs alongside core industrial clusters and ports to allow hydrogen trade. A sizeable proportion of industrial activity occurs outside of the main industrial clusters and should not be overlooked. These hubs, which can combine different user types and sizes, would bring together demand with local production, mitigating the reliance on long-distance transportation and national pipelines. By aggregating users, it is possible to decouple production from demand and deliver a smoother overall demand profile, thus reducing risk and allowing producers to operate more economically. Hub elements to be invested in include low carbon hydrogen production, local pipelines[10], users and hydrogen refuelling infrastructure.

Inland hydrogen hubs could be connected to national hydrogen infrastructure in the future to become prosumers, supplying demand further afield. This approach would also help to accelerate hydrogen roll-out across the UK, thus aligning with the Modern Industrial Strategy's objective to maximise regional growth outside of London and the South East.

In addition to supporting inland hubs, we would also like to see risk-taking intermediary between low carbon hydrogen producers and users being eligible under the Hydrogen Allocation Round process. Current requirements under the HPBM are for hydrogen producers to have bilateral agreements with users for the full contract period of 15 years. For the reasons outlined above, this is challenging.

The HEA considers Great British Energy to be well placed to both deliver inland hydrogen hubs and act as a risk- taking intermediary in line with the Industrial Strategy.

While supporting the development of inland hubs and the eligibility of risk-taking intermediaries would support increased demand for hydrogen, the government must also look to stimulate the uptake of hydrogen in a more direct way. An obvious starting point would be to extend the HPBM to include demand side funding for end users looking to switch to hydrogen; as discussed in Question 7, for many the infrastructure investment costs are significant. For example, there is an absence of capital grants for power plants at above 500MW capacity; given that the required investment cost in such plants is one million pounds per MW, this is a significant barrier for hydrogen uptake in the power sector. If demand for hydrogen is to achieve the expectations set out in the Hydrogen Transport and Storage Networks Pathway, including as much as 70TWh of hydrogen for the power sector alone by 2050, it is crucial that end user communities receive sufficient funding. We note the recent publication of NESO's

[10] Note that with hydrogen scheduled to be out of scope for RIIO-3, there is no clear funding mechanism for local pipeline connections - https://www.ofgem.gov.uk/sites/default/files/2024-07/RIIO_3_SSMD_Overview.pdf

'Clean Power 2030[11]' report, and its conclusion that that hydrogen and CCS "*add significant value to the system, with even relatively small levels of operational capacity materially reducing the overall challenge for the rest of the programme*". Work to deliver the Clean Power Mission will be an important complement to outcomes of this Industrial Strategy.

At present, other than for Sustainable Aviation Fuel (SAF), prospective low carbon hydrogen (and ammonia) end-users (such as heavy industry, freight, maritime) have little incentives to put time, money and effort into decarbonising operations in the UK because there are no mandates or requirements to do so (i.e. no penalties for not decarbonising). In the EU, mandates are creating incentive to deploy capital to make changes today.

Additionally, no user is willing to convert unless they are indirectly supported by the HPBM such that the overall cost which is lower than that of natural gas today. As a result, the market is paralysed; hydrogen uptake, and therefore production, is limited to projects which receive HPBM support. Without requirements to decarbonise today, users simply won't pay more than is seemingly available to them through HPBM and so will wait for a HAR project. However, these projects cannot proceed without confidence in longer term market developing with a suitable market price for hydrogen.

As hydrogen is a nascent, technology-driven market, sufficient focus must be given to the development phase of innovation. This is a critical phase where competitive capability is established, market leadership is secured, supply chains are grown, and deep-rooted capital investment is anchored into the domestic economy. As noted above, the Hydrogen Innovation Initiative is playing a major role in defining how Government can stimulate innovation in UK supply chains. Engagement with industry is ongoing to define the interventions which will allow businesses, government and academia to converge, focus investment and deliver the high economic growth opportunities that the UK needs. The HEA is closely involved in this work, and supportive of the outcomes.

The UK has a diversity of SMEs poised and ready to help deliver the hydrogen economy. Whilst Innovate UK and other bodies have a strong track record in supporting collaborative R&D, there is a dearth of funding to facilitate scale-up and help companies bridge the 'valley of death'. In contrast, the EU provides mechanisms such as the EIC Accelerator [12] which are directly targeted to meet this need. The Accelerator provides both grant funding (up to €2.5 million) and direct investment (up to €15 million). The HEA recommends that a similar approach be adopted for the UK. Other examples of good practice include those from the USA, where a suite of programmes is available to support innovation and commercialisation in SMEs[13] [14].

The Hydrogen Innovation Initiative, described in Question 5, has the potential to help companies cross the 'valley of death', with planned mechanisms including:

- *HII – A Strategic Delivery Body: a strategic co-ordination and delivery organisation working across the E2E value chain, strengthening the public private partnership and delivery of impact.*

- *Hydrogen Enabling Asset Fund: a network of innovation assets that enables industry to de-risk technology industrialisation, accelerate adoption and increase market confidence.*

[11] https://www.neso.energy/document/346651/download

[12] https://eic.ec.europa.eu/eic-funding-opportunities/eic-accelerator_en

[13] https://www.insme.org/innovation-policies-for-smes-in-the-u-s/

[14] https://medium.com/@yuehan086ll/emerging-private-sector-solutions-to-bridge-the-clean-energy-valley-of-death-7efc54f1c45e

- *National Supply Chain Accelerator: a strategic supply chain development programme that accelerates growth and anchors investment into UK companies.*

- *HIIP - Hydrogen Innovation and Industrialisation Programme: a business-led innovation and technology development programme that accelerates technology innovation to market and grows capacity by anchoring investment into the UK economy.*

- *HIITech - Hydrogen Technology Institute: a challenge led discovery programme that harnesses UK's world leading institutions to deliver next generation technology and transformative innovations.*

Finally, we would like to highlight the value in supporting projects at all scales and low carbon production pathways. Small projects lay the groundwork for larger successors and allow for learning and the development of economies of scale. However, investment bodies often have minimal lending criteria which prevent the inclusion of smaller projects. We support the recommendation of the Energy Systems Catapult regarding the establishment of a Hydrogen Debt Fund, which could help finance the small projects that are needed to kickstart a liquid hydrogen market[15]. Sufficiently supporting the development of smaller projects is a principle that should be applied systemically across the hydrogen economy.

Q.14. Where you identified barriers in response to Question 7 which relate to planning, infrastructure, and transport, what UK government policy solutions could best address these in addition to existing reforms?

Low carbon hydrogen production faces parallel challenges to those in renewables in securing planning consent and grid connection. Our recommendations in this regard are:

- Ensure that hydrogen falls within the remit of project development support proposed for renewables via the new partnership between Great British Energy and the Crown Estate – including securing planning consent and grid connection.

- Develop clearer guidance for all parties in the planning process, together with standardisation and training for officers (including the HSE and Environment Agency. The development of wider frameworks, together with capability and capacity building in planning departments, will reinforce Great British Energy's work in this area. Our recently published Action Plan for Electrolytic Hydrogen provides more details on how the planning process can be simplified[16].

- Ensure that hydrogen projects are given equal priority with other grid-connected assets seeking connections.

The importance of timely grid connections cannot be stressed enough. Clear timescales and certainty are vital in unlocking the development of hydrogen developments and have been a "showstopper" in numerous early-stage projects already.

[15] https://es.catapult.org.uk/report/debt-financing-low-carbon-hydrogen-projects-in-the-uk/?reportDownload=https://esc-production-2021.s3.eu-west-2.amazonaws.com/wp-content/uploads/2024/07/23100958/Debt-financing-low-carbon-hydrogen-projects-in-the-UK_Executive-Summary.pdf

[16] https://ukhea.co.uk/policy-shaping/

Hydrogen transportation and storage infrastructure has a key role in the hydrogen economy, linking producers and users, and storing energy to balance offshore wind and solar when the wind isn't blowing and the sun isn't shining (delivering potential savings of £38bn, as noted above)[17]. Whilst the HEA has been encouraged to see the recent news that the National Energy System Operator (NESO) has been commissioned by government to develop a Strategic Spatial Energy Plan, including hydrogen transportation and storage assets, we note that this will not be available until 2026. In parallel, business models are planned for the end of next year. With low carbon hydrogen production developing to meet our 10GW target by 2030, there is an urgent need to accelerate timelines. In addition, non-pipeline transportation has an important role to play on both bridging the temporal gap while pipelines are developed, and in providing ongoing connectivity for remote producers and users. Non-pipeline transportation methods offer several benefits over and complementarities to pipelines, including short timeframes for implementation, full geographical flexibility and the ability to deliver high-purity hydrogen. The different modes of non-pipeline transportation, including road, rail, and sea transportation, provide further flexibility and optionality. See question 15 for our recommendations on how non-pipeline transport can best be supported to meet the strategic need.

It is worth noting that the development of hydrogen in the UK will help to ease pressure on the electricity grid and related challenges linked to grid connections and capacity. With appropriate infrastructure in place, it will form a complementary route for storing and moving energy from point of production to use. Ensuring that the UK moves forward with the full range of low carbon hydrogen production options in the short term will help to accelerate progress and smooth the overall transition.

As mentioned in Question 7, a significant barrier to hydrogen investment is the associated technology and infrastructure costs. This is particularly the case for large industrial users with large amounts of existing infrastructure with potentially long asset lives remaining. To make the switch to hydrogen as attractive and viable as possible, it is key that any government funding intended to upgrade and repurpose existing infrastructure for hydrogen solutions must account for any value still to be reclaimed over the remaining asset life.

Ports are another element of infrastructure which are important to hydrogen, alongside production, storage, transportation and use. It will be important that ports are developed to allow trade in hydrogen and its derivative.

Every £1 of construction investment results in a £2.92 boost to the overall economy[18]. Thus, investment in infrastructure not only supports the Industrial Strategy but the entire economy. In this context, we are supportive of Treasury's plans to introduce relaxed debt rules, allowing billions to be borrowed for infrastructure projects while maintaining oversight to ensure value for money. This will be a valuable step in the right direction to reducing the barriers to investment in infrastructure.

In terms of facilitating the initial investment into hydrogen infrastructure, more measures must be taken to limit the burden of additional costs associated with the use of hydrogen infrastructure and equipment, including network charges, energy inputs, and levies. This not only means amending unduly burdening policies, such as the CCL mentioned in Question 7, but also protecting low carbon hydrogen projects from volatile energy prices. Government should consider offering a such projects the opportunity to fix a portion of their power input costs, as has been successfully implemented in renewable CfDs, in order to limit the input costs faced by hydrogen producers.

[17] Benefits of long-duration electricity storage (publishing.service.gov.uk)

[18] https://www.cbi.org.uk/media/4121/fine-margins-february-2020-cbi.pdf

With regard to mobility, it will not be possible to decarbonise our transport system without hydrogen. In heavy transport, in particular, hydrogen delivers greater range, faster refuelling, higher payload and better functionality in challenging environments than electrification. The UK is lagging behind peer nations in accelerating roll-out (see Question 18), with the UK approach being patchy and non-strategic. The HEA's response to the previous Government's 'Low Carbon Fuels Strategy – Call for Ideas'[19], includes a series of recommendations to address this. These include:

- Development of a hydrogen for transport strategy – recognising the complexities, scale of action needed and link across to other areas of the hydrogen economy
- The setting of specific, quantifiable targets that drive forward hydrogen for transport (as peer nations have done), combined with strong compliance incentives (e.g. fines for non-compliance),
- A commitment to ensuring that at least 20% of the government's 40,000 strong fleet of vehicles transition to hydrogen by 2030
- CAPEX and OPEX funding across all aspects of hydrogen as a transport fuel – vehicles, hydrogen refuelling infrastructure etc.
- Defining Hydrogen combustion as a zero-emission transport option.

More broadly, there must be consistency across the entire mobility sector in terms of emission mandates and targets. The subsectors of rail, marine, and NRMM must be aligned with road transport and aviation. Synchronised action is needed on all fronts to avoid a fragmented and siloed approach to decarbonisation.

It is evident that, unless the UK fuel strategy changes drastically, the UK will miss the opportunity to acquire a share of the associated technology market and risk becoming reliant on imports. Recognising the modification of existing Internal Combustion Engines (ICE) and the rollout of purpose-built hydrogen ICEs as an eligible technology within the zero emissions vehicle (ZEV) mandate, would be a fast way of stimulating demand in the road transport sector, whilst bringing a substantial amount of hydrogen fuel into circulation.

In terms of directly incentivising the uptake of hydrogen use as a fuel in the road transport sector, the UK must develop and work towards a £/kg fuel price target for hydrogen that is competitive with EU estimates. The EU Hydrogen Strategy outlines a price of between €2.5 and €5.5/kg for renewable hydrogen at the pump by 2050[20]. If the UK does not aim for a similar price parity soon, there is a substantial risk to the development of the UK hydrogen market, as customers will look to Europe to procure competitively priced hydrogen for use as fuel.

As well as the aforementioned recommendations for accelerating the rollout of a hydrogen transport network and decreasing the pump price of hydrogen, the UK should increase the ambition of the development fuel sub-target of the Renewable Transport Fuel Obligation (RTFO) (currently set at 3.39% by 2032[21]) in order to drive hydrogen demand. The associated certificate price (currently £0.80 per litre) must also be supported for Development Renewable Transport Fuel Certificates (dRTFCs) by a Floor Price or Auto ratchet mechanism to provide long term investment security and incentivise the fuel industry.

---

[19] https://ukhea.co.uk/policy-shaping/hea-consultation-response-low-carbon-fuels-strategy/

[20] file:///C:/Users/gwool/Synnogy%20Ltd/UK%20HFCA%20-%20Documents/Johnny%20Files/HEA%20Policy%20Notes/EU/CELEX_52020DC0301_EN_TXT.pdf

[21] https://www.gov.uk/government/consultations/renewable-transport-fuel-obligation-addressing-multiple-incentives/outcome/government-response-to-renewable-transport-fuel-obligation-addressing-multiple-incentives

As with other aspects of hydrogen, action in these areas will deliver not only decarbonisation, but support a range of UK based supply chain companies active in hydrogen refuelling, vehicles, components and NRMM. The latter alone is estimated to have been worth over £17.6bn to the UK in 2022, with over 83% of revenue from export and employing around 100,000 people (~31,000 direct and 68,000 indirect). It represents a significant pillar of the UK economy. This significant revenue comes from key global manufacturers with 9 equipment manufacturers and a range of tier one suppliers[22].

Q.15 How can investment into infrastructure support the Industrial Strategy? What can the UK government do to better support this and facilitate co-investment? How does this differ across infrastructure classes?

To support the development and deployment of non-pipeline transportation methods for hydrogen, the government should either allow more funding scope for projects with larger transport and storage infrastructure requirements within the HARs, or include non-pipeline transportation within the upcoming Hydrogen Transport and Storage Business Model, which is currently limited to pipeline projects. On the whole, the HPBM has been successful in attracting private investment and improving long-term stability for the industry. By adopting a similar approach for non-pipeline transportation, the government can help to establish a funding mechanism for the transport of hydrogen which will aid in servicing a greater variety of regions prior to the commissioning of a functional hydrogen pipeline network (see Question 14).

Tube trailers, a key component of non-pipeline transport, represent a high value global technology market with UK strengths. To ensure that the UK is well placed to take a significant share of this market, alongside the measures outlined above, the HEA also recommends that government focus on improving manufacturing capacity, supporting the currently high investment costs, and closing the maintenance, skills and infrastructure gap.

See our comments on infrastructure to support hydrogen mobility in Question 14.

As previously mentioned in Question 7 and 10, hydrogen funding has not given sufficient consideration to the demand side of the industry. Supporting the infrastructural investment of end users looking to convert to hydrogen is key for accelerating the development of a world leading hydrogen economy that is capable of delivering the economic potential referenced by the HII in Question 4. The HBM or any subsequent funding mechanisms should be diversified to include CAPEX and OPEX funding for end users, as well as producers. Government should target funding to consider projects as a whole, rather than in isolated parts. In the absence of support frameworks which synergistically cover the full value chain from production to user, projects will stall or simply not happen.

Hydrogen enables industrial growth far beyond production facilities; it is a catalyst in supporting the green industries of the future. Enabling investment in low carbon hydrogen infrastructure must be a key part of the Government's Industrial Strategy to ensure that the UK remains at the forefront of decarbonisation efforts and the low carbon products market. We believe that reducing the cost of industrial decarbonisation by providing cost-efficient hydrogen will additionally encourage further industrial development. The HyNet North West Cluster provides additional powerful evidence of the effect and the same impact can be expected in other clusters.

[22] https://ukhea.co.uk/policy-shaping/

Q.18 Where you identified barriers in response to Question 7 which relate to competition, what evidence can you share to illustrate their impact and what solutions could best address them?

The EU is developing a strategy to support the full hydrogen value chain, with a focus on delivering clean growth, decarbonisation and net zero. Of particular relevance in the context of competition are the targets for the use of hydrogen:

- Renewable hydrogen targets: The EU has set targets for increasing the use of renewable hydrogen in industry and transport. The target for industry is 42% renewable hydrogen by 2030 and 60% by 2035. For transport, the target is a 1% share of renewable fuel of non-biological origin (RFNBO) by 2030.

- Hydrogen refuelling stations: The EU has mandated that hydrogen refuelling stations be installed every 200 on the main EU roads and in all major cities by 2030.

Use targets are to be cascaded down into national frameworks. A similar approach in the UK would be beneficial in addressing competitive pressures and would be aligned with mechanisms that have been introduced to support, for example, SAF. Any targets will need to be fully enforceable and need with clear incentives to comply (e.g. fines for non-compliance).

Q.20. Do you have suggestions on where regulation can be reformed or introduced to encourage growth and innovation, including addressing any barriers you identified in Question 7?

Hydrogen and decarbonisation legislation should remain technology-agnostic and welcome any hydrogen production pathway that meets LCHS or RTFO standards and the stated objectives and criteria of the Industrial Strategy (including economic growth, carbon intensity, cost, resources, speed of implementation).

The Hydrogen Coordination Forum[23], convened by the HEA, has identified a series of ten 'Quick Win' policy reforms[24] that, collectively, would support significant, and quicker, growth of the UK hydrogen economy and release private investment faster into the market – results that are essential to meeting the Government's hydrogen objectives set out in the Clean Energy Superpower Mission and Industrial Strategy. Many of these 'Quick Wins' reflect the early stage of the industry and represent opportunities to 'smooth the path' going forward; in summary, they comprise:

- Stimulate demand to accelerate overall roll-out
- Simplify planning framework to reduce costs and delays
- Reconfirm commitment to hydrogen for net zero to bolster investor confidence
- Clarify role for blending to enable project developers to better plan
- Allow Risk Taking Intermediaries in Government funding for hydrogen production to mitigate producer volume risk
- Reduce temporal correlation requirements for project developers on a temporary basis to improve cost competitiveness

[23] Members of the Hydrogen Coordination Forum include members including Renewables UK, the REA, Hydrogen East, the North-West Hydrogen Alliance, Scottish Renewables, Hydrogen Southwest, the Carbon Capture and Storage Association, the Decarbonised Gas Alliance, and the Midlands Hydrogen and Fuel Cell Network.

[24] https://ukhea.co.uk/policy-shaping/

- Include Hydrogen internal combustion (ICE) in definitions of zero emission transport to allow the UK to reap economic and employment benefits across UK manufacturing
- Develop hydrogen refuelling standards to support roll-out of hydrogen mobility in the UK
- Include hydrogen within the Venture Capital Scheme to enhance access to venture capital
- Enhance role for regions in hydrogen roll-out to embed benefits nationally

Further details on many of these points are included in our answers to earlier questions, as well is in the document itself. Regarding the need to stimulate demand, targets for hydrogen use (equivalent to Europe's REDIII industrial and transport mandates – see also Question 18) combined with strong compliance incentives (e.g. fines for non-compliance), CAPEX support, and development of inland hydrogen hubs where lower-risk shorter term contracts between producer and users would be more feasible will all be important (see Question 6).

The power sector is an area of policy that is somewhat lagging behind other areas of the hydrogen economy, yet DESNZ has noted power derived from hydrogen as integral for the UK's future energy system resilience and security. Hydrogen-to-power technology has particularly good credentials for peaking plants, which can use hydrogen held in large scale storage facilities during times of high energy demand. Hydrogen power plants, working in tandem with a growing transport and storage network, will be an essential balancing mechanism to allow the UK to continue to grow its world leading renewable energy portfolio, which includes 50 GW of additional offshore wind capacity by 2030[25].

To realise this potential and allow the UK energy system to continue to grow, a framework for tracing the green credentials of renewable hydrogen in the grid must be developed, as currently any electricity generated with green hydrogen is not considered green and cannot be used to power HAR projects, for example. If the government expects hydrogen-to-power to play a 'critical role in supporting both the decarbonisation of the power sector and security of electricity supply, alongside providing decarbonisation pathways for unabated gas generation'[26], the policy landscape must become more favourable so as to incentivise the switch away from fossil fuel alternatives.

Q.25. Which international markets do you see as the greatest opportunity for the growth-driving sectors and how does it differ by sector?

Our members highlight the USA and mainland Europe[27], particularly Germany, France and The Netherlands as international markets of greatest interest. Across the USA, the development of regional clean hydrogen hubs, with up to $7bn of funding, together with the tax credits[28] of up to $3/kg clean hydrogen produced, under the Inflation Reduction Act, have both been major catalysts for progress.

Hydrogen trade corridors opening up between Europe, North Africa, the United States and the Middle East. The international trade of low carbon hydrogen will become a major enabler of growth. The

[25] https://www.gov.uk/Government/publications/british-energy-security-strategy/british-energy-security-strategy

[26] https://assets.publishing.service.gov.uk/media/657a2ea2095987001295e071/hydrogen-to-power-need-design-for-business-model.pdf

[27] https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen_en#:~:text=of%20technological%20innovations.-,EU%20hydrogen%20initiatives,and%20innovation%20initiatives%20on%20hydrogen.&text=The%20Clean%20Hydrogen%20Partnership%20(2021,the%20Commission%2C%20through%20Horizon%20Europe.

[28] Tax credit available for 10 years for facilities that start construction before 2033. The hydrogen must have life-cycle greenhouse gas emissions below 4 kg CO2 equivalent per 1 kg of hydrogen.

Hydrogen Council has found that the cost of the energy transition globally can be reduced by £3.2 trillion through trade in hydrogen at scale[29].

Making sure UK based industry have access to sufficient low carbon hydrogen to produce low carbon products for the UK market and for export (e.g. glass, steel, SAF) will be key. Without enough low carbon hydrogen available and / or affordable electricity, these products will not be produced in the UK and will themselves need to be imported.

Therefore, to reduce administrative burdens and build consumer trust, it is imperative that the UK Low Carbon Hydrogen Certification system and other international standards are mutually recognised. The UK Government needs to work with international organisations to minimise deviations between the schemes, albeit with appropriate grandfathering for projects which were brought in under earlier versions. This will build on the success of other international collaborations on sustainability that the UK has actively supported, and which have common certification standards at their core, such as the Clean Energy Ministerial. To enhance investor certainty, DESNZ needs to set out a roadmap of how and when international harmonisation will be in place. In the absence of a common certification and accounting framework or associated international agreement, this could create a global hydrogen market failure through market fragmentation and duplication.

[29] https://hydrogencouncil.com/wp-content/uploads/2023/11/Global-Hydrogen-Flows-2023-Update.pdf